

Appl. No. 10/633,241
Reply to Office Action of June 27, 2005

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application:

1. (currently amended) A method for detecting an endpoint of a chemical mechanical planarization (CMP) process comprising the steps of:

providing a light pulse on an area of a surface of a semiconductor wafer;

receiving light reflected from said area of said surface and obtaining a measurement of said reflected light;

tracking a location of said area from which said measurement is obtained;

analyzing a reflectance spectra associated with said measurement and said location of said area from which said measurement was obtained; and

repeating said steps listed hereinabove until an intermediate reflectance spectra is identified that has a sinusoidal shape when normalized; and

adjusting a parameter of the CMP process based on an analysis of said reflectance spectra and said location associated therewith.

2. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 1 further ~~including~~ comprising the steps of:

identifying a change in said reflectance spectra corresponding to a layer of material being removed from said surface by the chemical mechanical planarization process and an underlying layer of a different material ~~[[is]]~~ being exposed; and

stopping the chemical mechanical planarization process.

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3. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 2 wherein said step of identifying a change in said reflectance spectra corresponding to a layer of material being removed from said surface by the chemical mechanical planarization process and an underlying layer of a different material ~~[[is]] being exposed further includes~~ comprises a step of overpolishing for a predetermined time period to ensure said layer of material is removed. ~~[[.]]~~

4. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 1 further ~~includes~~ comprising the steps of:

continuing the chemical mechanical planarization process for a predetermined time period; and

stopping the chemical mechanical planarization process after said predetermined time period.

5. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 1 wherein said step of providing a light pulse on an area of a surface of a semiconductor wafer further ~~includes~~ comprises the step of using a broadband spectrum of light such that an intensity of said reflected light is analyzed over a plurality of wavelengths.

6. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 5 wherein said step of using a broadband spectrum of light such that an intensity of said reflected light is analyzed over

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a plurality of wavelengths further ~~includes~~ comprises a step of providing light in a range of 300 to 800 nanometers in wavelength.

7. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 1 wherein ~~[[in]]~~ said step of analyzing a reflectance spectra further ~~includes~~ comprises a step of performing a fast fourier transform analysis on said reflectance spectra.

8. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 1 wherein said step of repeating said steps listed hereinabove until an intermediate reflectance spectra is identified that has a sinusoidal shape when normalized further ~~includes~~ comprises the steps of :

varying a location of said light pulse on said surface of said wafer; and

taking a diversity of reflectance spectra over time such that an entire surface of said semiconductor wafer is represented by said measurements in determining material uniformity, thickness, and removal rate.

9. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 1 wherein said step of providing a light pulse on an area of a surface of a semiconductor wafer further ~~includes~~ comprises a step of providing said light pulse for a time period of approximately ten microseconds or less.

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10. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 1 wherein said step of providing a light pulse on an area of a surface of a semiconductor wafer further ~~includes~~ comprises a step of providing said light pulse having a spot size larger than a largest feature size to remain on said semiconductor wafer after the CMP process.

11. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 1 wherein said step of providing a light pulse on an area of a surface of a semiconductor wafer further ~~includes~~ comprises a step of using more than one probe to pulse and receive light.

12. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 11 wherein said step of using more than one probe to pulse and receive light further ~~includes~~ comprises the steps of:

using more than one probe to pulse and receive light such that each probe measures a concentric band on said surface and said concentric bands measured by each probe combine to represent an entire surface of said semiconductor wafer; and

overlapping measurements of each probe to an adjacent concentric band.

13. (currently amended) A method for detecting an endpoint of a chemical mechanical planarization (CMP) process comprising the steps of:

taking reflectance spectra data periodically on different areas of a surface of a semiconductor wafer during the CMP process and tracking a location of each of said different areas from which said reflectance spectra is taken;

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identifying a first reflectance spectra corresponding to a first layer of material on [[a]] at least one of said different areas of said surface of [[a]] said semiconductor wafer such that said first reflectance spectra comprises light reflected predominately from said first layer of material;

identifying a second reflectance spectra corresponding to said first layer of material on said surface being thinned such that said second reflectance spectra is modified by a second layer of material underlying said first layer of material; and

identifying a third reflectance spectra corresponding to said first layer of material on said surface being substantially removed such that said third reflectance spectra comprises light reflected predominately from said second layer of material; and

adjusting a parameter of the CMP process based on an analysis of said reflectance spectra and said location associated therewith.

14. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 13 wherein said step of taking reflectance spectra data periodically on different areas of a surface of a semiconductor wafer during the CMP process further ~~includes~~ comprises a step of using a broadband spectrum of light ranging from 300 to 800 nanometers in wavelength to generate said reflectance spectra data.

15. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 13 further ~~includes~~ comprising the steps of:

normalizing said reflectance spectra data to said first reflectance spectra; and

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identifying when said normalized reflectance spectra data changes from an approximately linear shape to an approximately sinusoidal shape that corresponds to said second reflectance spectra.

16. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 15 further ~~includes~~ comprising the steps of:

continuing the CMP process for a predetermined time period; and

ending the CMP process after said predetermined time period.

17. (currently amended) The method for detecting an endpoint of a chemical mechanical planarization (CMP) process as recited in claim 15 further ~~includes~~ comprising the steps of:

identifying when said normalized reflectance spectra data changes from said approximately sinusoidal shape to an approximately linear shape that corresponds to said third reflectance spectra data;

overpolishing for a predetermined time period; and

ending the CMP process after said predetermined time period.

18. (currently amended) A method of wafer processing including end point detection for a chemical mechanical planarization process (CMP) comprising the steps of:

forming at least one trench in a dielectric layer of a semiconductor wafer;

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depositing a barrier material on a surface of ~~[[a]]~~ said semiconductor wafer such that said barrier material forms a layer on a bottom and sidewalls of said at least one trench;

depositing copper on said surface of the semiconductor wafer such that said at least one trench is filled with copper;

performing a first CMP process to remove a layer of copper on said surface of the semiconductor wafer such that said copper remains in said at least one trench;

initiating a second CMP process to remove said layer of barrier material on said surface of the semiconductor wafer;

taking reflectance spectra data on different areas of said surface of said semiconductor wafer using a broadband spectrum of light ranging from 300 nanometers to 800 nanometers in wavelength and tracking the locations of said different areas from which said reflectance spectra data is taken;

identifying when ~~said barrier metal has been thinned such that~~ said reflectance spectra data taken from said locations is modified by said dielectric layer underlying said barrier layer material to assess when said barrier material has been thinned at said locations; and

continuing with said second CMP process knowing an approximate thickness of said barrier layer material that remains.

19. (currently amended) The method of ~~manufacturing as recited in claim 18~~ further including comprising a step the steps of:

identifying when said reflectance spectra data corresponds to reflected light predominately from said dielectric layer; and

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overpolishing to ensure complete removal of said barrier material on said surface of the semiconductor wafer.

20. (currently amended) The method of ~~manufacturing as recited in~~ claim 18 wherein said step of depositing a barrier ~~metal~~ material on a surface of a semiconductor wafer such that said barrier ~~metal~~ material forms a layer on a bottom and sidewalls of said at least one trench further ~~includes~~ comprises a step of depositing tantalum or tantalum nitride as said barrier material.

21. (currently amended) The method of ~~manufacturing as recited in~~ claim 18 ~~wherein said step of depositing a barrier metal on a surface of a semiconductor wafer such that said barrier metal forms a layer on a bottom and side walls of said at least one trench further includes a step of depositing tantalum nitride as said barrier material~~ further comprising the step of adjusting a parameter of the CMP process based on an analysis of said reflectance spectra data and said locations associated therewith.